

### UPHOLSTERED FURNITURE MOCK UPS FLAMMABILITY TEST RESULTS ON **API - REVIEW AND ANALYSIS OF**

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Consumer Product Safety Commission June 18, 2002



To reduce the incidence of fire residential upholstered furniture. deaths and injuries associated with



# **TECHNICAL OBJECTIVES**

- Develop flammability data representative of residential upholstered furniture
- Evaluate mass loss technique as representative of early fire development
- Analyze and interpret data, develop method for presenting results



### SUMMARY

- Procedure based on BS 5852 small test rig
- Fabric/foam composite specimen (with interliner or batting)
- "Source 1" small flame ignition burner
- Mass measurements taken at intervals
- "Source 1" ignition flame only
- Test end point at 10 min. or 10% mass loss



## Testing Scope

#### Foams

- Conventional, non-FR, 1.72 pcf, 170 cfm/ft<sup>2</sup>
- Cal. 117, 1.75 pcf, 213 cfm/ft<sup>2</sup>
- BS 5852 Crib 5, 1.75 pcf, 56 cfm/ft<sup>2</sup>

#### Fabrics

- 32 Commercially available U.S. upholstery fabrics
- 8 FR Backcoated, BS 5852 Source 1 compliant



## Testing Scope

#### Batting

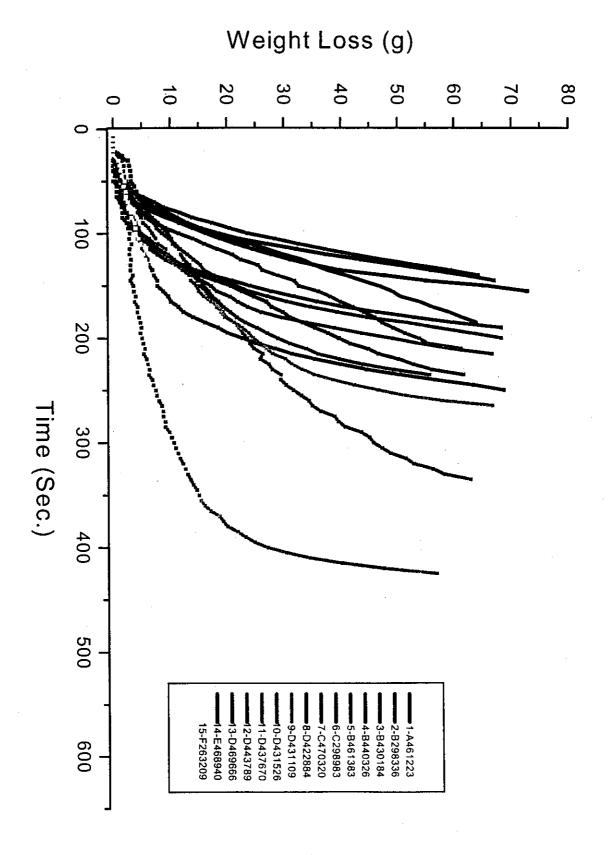
- Slickened, adhered to Cal. 117 Foam
- Non-slickened, BS 5852 Source 2 compliant
- Compliant to Cal. 117 draft standard

### Interliners

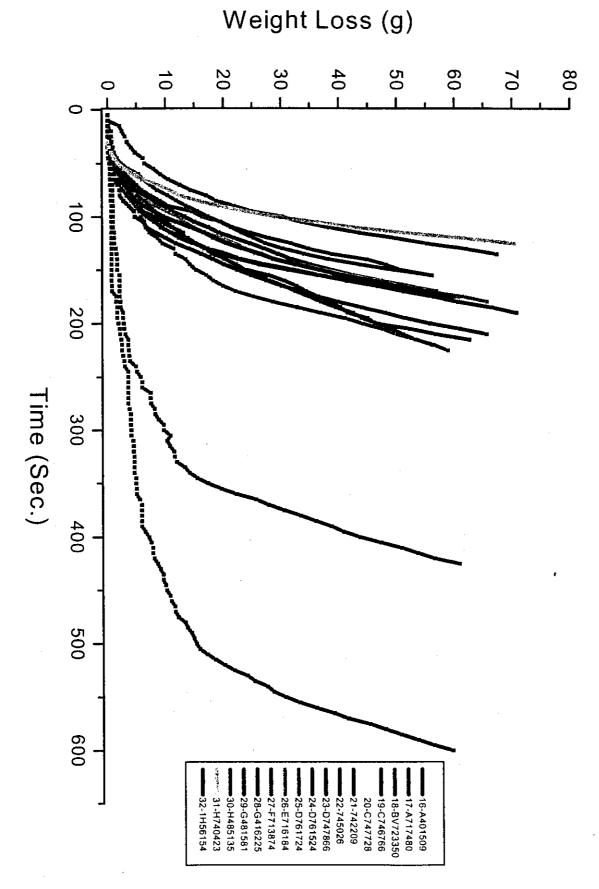
2 Blended Basofil/Aramid

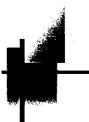
#### Fabrics

32 U.S. commercially available, widely sold fabrics tested



Comparison Graph Fabrics 16-32/BS5852 Foam/Source 1





# Use of Polyester Batting

- Use of adhered batting degrades performance
- Use of UK compliant batting does not foam and commercial U.S. fabrics impede flame propagation with Crib 5

## Fabric 11/BS5852 Foam/Source 1

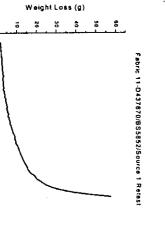


Ignition



Fabric ID

Minutes

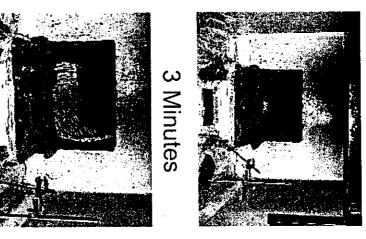


00

200 Time (Sec.)

400



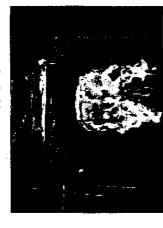


% Weight Loss Fabric 11-D437670/8S5852/Source 1 Relest 100 200 300 Time (Sec.) 300 **6** 500

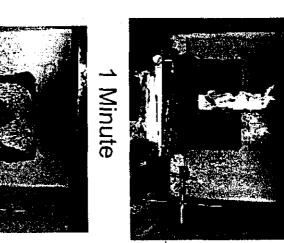
# Fabric 11/BS5852 Foam/5852 PE Batting/Source 1 Ign.



Sample ID



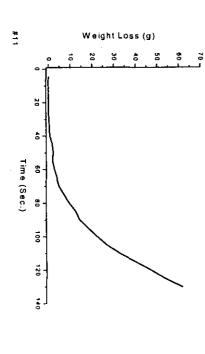
2 Minutes





Final

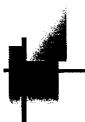
Fabric 11-D437670/BS5852/5852, Source 2 Compliant Batting





# FR Backcoated Fabrics

- 8 of 8 UK FR backcoated fabrics selfextinguished
- 2 of 2 of these self-extinguished with Source 2 ignition flame



### Interliners

- 2 FR interliners were tested with non-FR foam
- Tested with 3 poorly behaved fabrics
- Did not allow foam to become involved in fire

# Fabric 17/Conv. Non FR Foam/Basofil Liner/Source 1



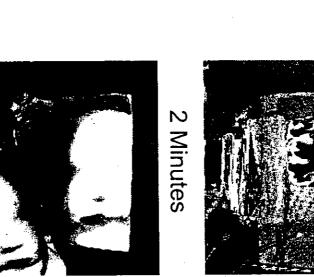
Sample ID



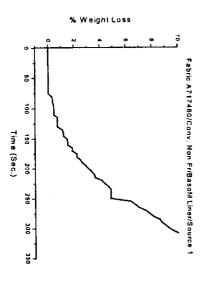
5 Minutes

Fabric A717480/Conv. Non FR/Basofil Liner/Source 1





Final



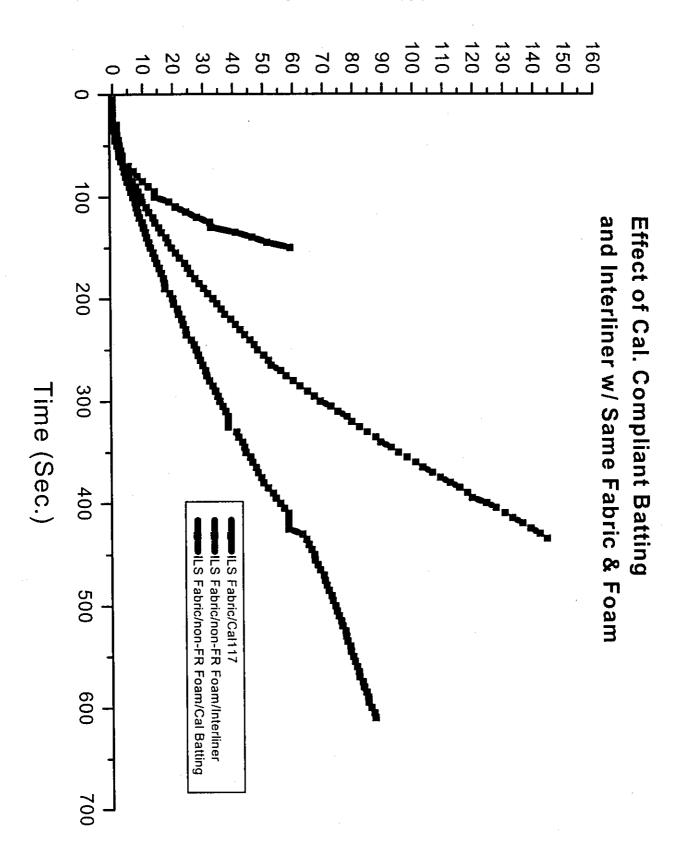
Weight Loss (g)

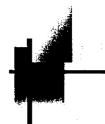
100

t50 z00 Time (Sec.)

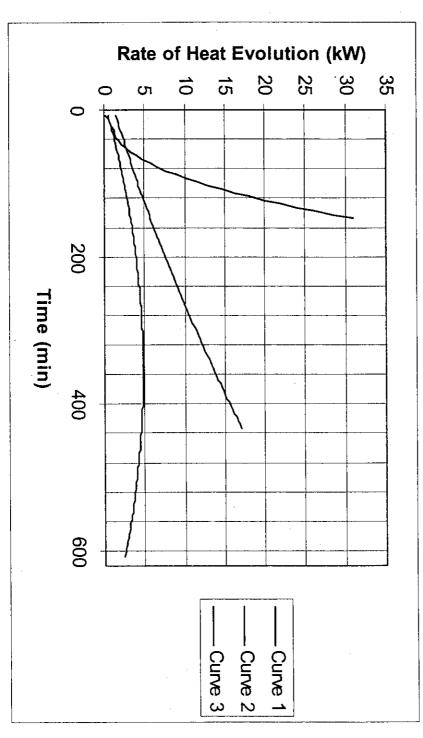
250

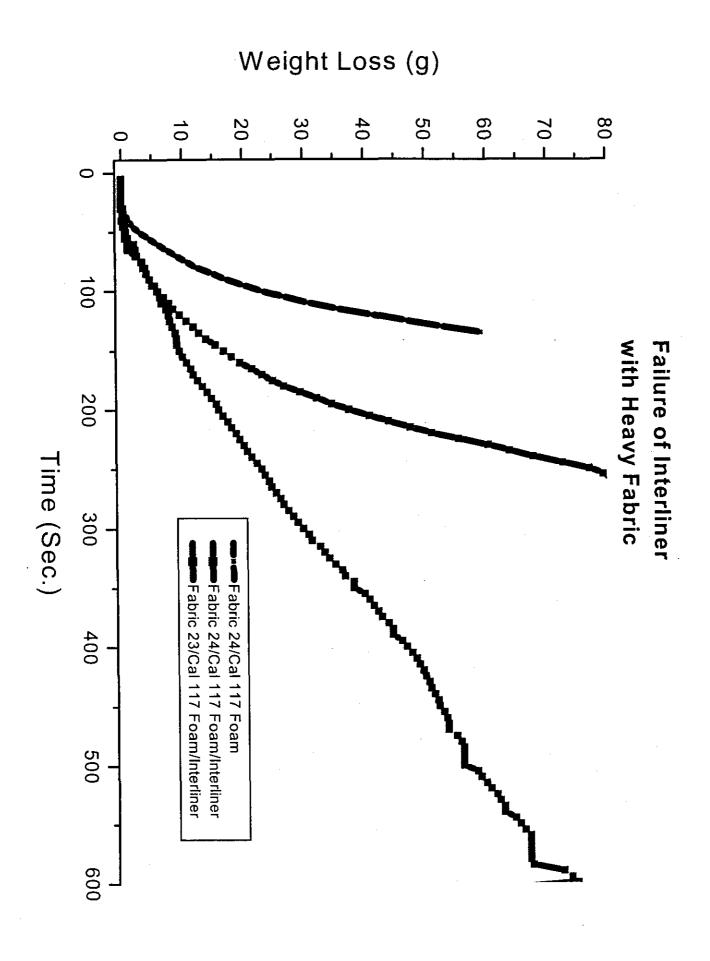
#### Weight Loss (g)





### Appr. HRR of Same Fabric + Foam with Interliner or Batting







## Use of FR Foam

- Mock-ups with heavily FR treated U.K. fire compliant foam became fully involved in
- Some additional FR protection, besides treated foam, for furniture is indicated



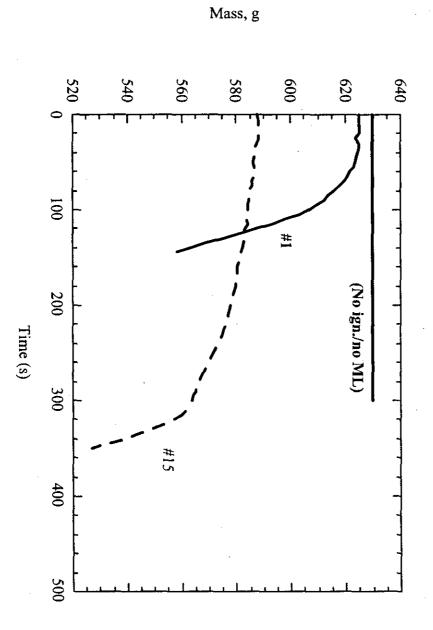
## Data Analysis



### SUMMARY

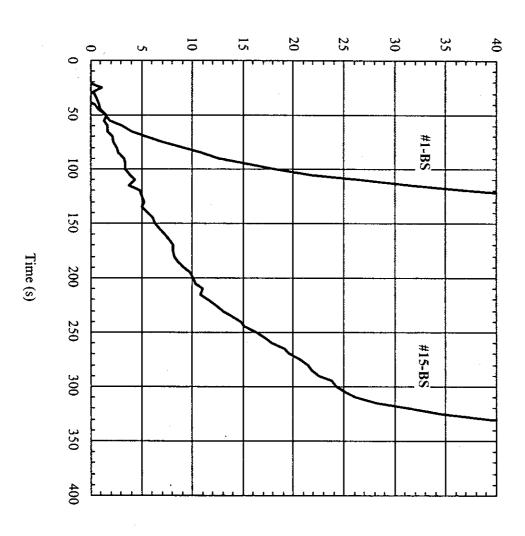
- Mass loss rate (MLR) an important factor
- Avg. MLR to 4 % ML initially selected
- Past 4 % ML, continue to burn
- Lab safety concerns
- MLR quantitative, related to HRR Average MLR simpler than MLR-time
- represents rate of burning
- Numerical result
- Newer thinking: MLR in 10 g increments

# Mass v. Time - Three examples

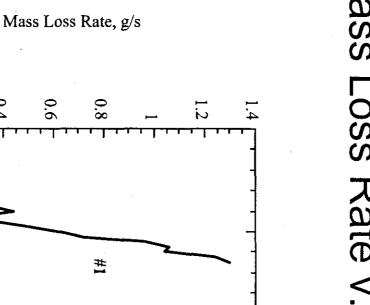


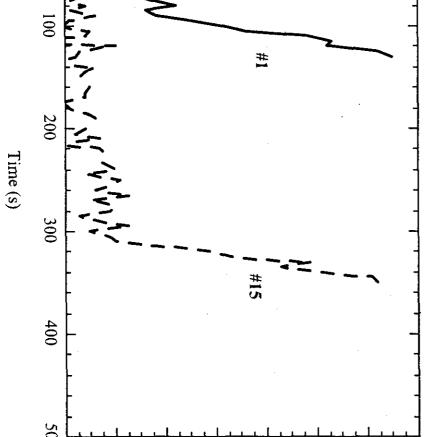
### Mass Loss v. Time





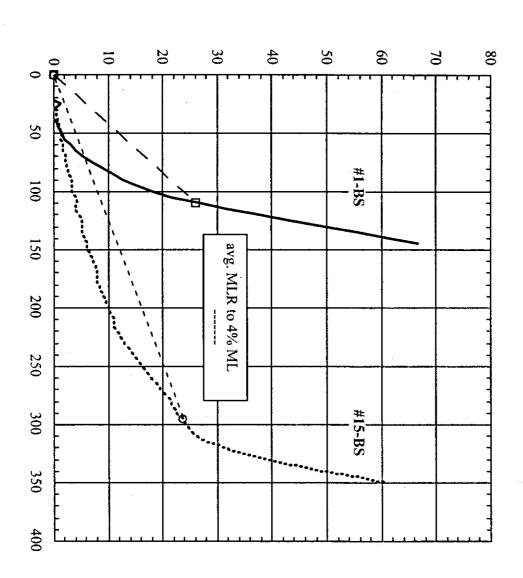
## Mass Loss Rate v. Time





# Mass Loss v. Time, Showing 4% ML

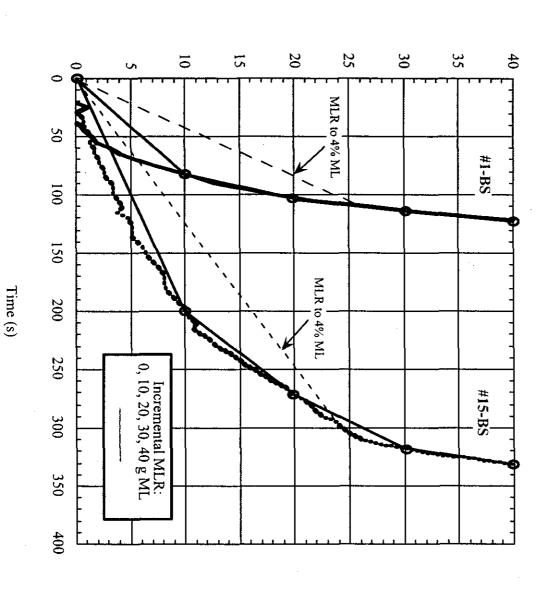




Time (s)

# Mass Loss v. Time, Showing Incremental MLR



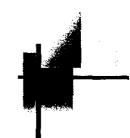




## RESULTS (1 of 4) Best Performers

- No ignition or self-extinction
- All 3 polyester fabric/polyester batting All 10 FR-backcoated fabrics
- Leather fabric on BS foam

tests



## RESULTS (2 of 4) Next Best Group

5 specimens using two different foams (BS, CAL)

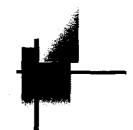
Tests with interliners



## RESULTS (3 of 4) Worst Performers

Most of the NFR foams

Most of the CAL/PET and BS/PET tests



## RESULTS (4 of 4) Repeatability

- 6 groups of tests, different fabric/foam combinations, 5 replicates of each
- % S. D. generally <10 %</li>
- Compares favorably with other flammability tests



# CONCLUSIONS - 1

- Mass Loss Rate (MLR) to given end Composite testing more predictive Not complicated to measure point(s)
- Unambiguous result for regulation Scientific measurement



# **CONCLUSIONS - 2**

- Minimal instrumentation required
- Results suitable for categorization or statistical analysis
- Test method suitable for wide range of furniture composites
- Potential for extrapolation to full scale
- Repeatability similar to other fire tests



# RECOMMENDATIONS

- Conduct further studies for repeatability and Practice E691 reproducibility (ILS) in accordance with ASTM
- Conduct full scale tests for comparison and tor estimation of HRR
- Further evaluate methods for classification of materials

#### <u>Upholstered Furniture Flammability Public Meeting June 18-19, 2002</u> <u>Testimony of the National Cotton Council</u>

I am Phillip J. Wakelyn, Ph.D., Senior Scientist, Environmental Health and Safety, National Cotton Council (NCC). This testimony is in response to the Consumer Product Safety Commission (CPSC) Notice of public meeting and request for comments regarding Regulatory Options for Addressing Upholstered Furniture Flammability (67 FR 12916; March 20, 2002).

The NCC is the central organization of the U.S. cotton industry, representing producers, ginners, oilseed crushers, merchants, cooperatives, warehousemen and textile manufacturers in 18 states. NCC represents approximately 25,000 cotton producers and about 1,000 gins that annually gin about 18 million bales of cotton. NCC mill members use over 7.5 million bales domestically to produce cotton textiles. NCC has a long history of commitment to product safety and has worked cooperatively with CPSC on flammability issues since CPSC was formed in 1974. Several of NCC member companies produce upholstered furniture fabrics and some cotton interest organizations make furniture components.

The behavior of cellulosic upholstery fabrics in flammability tests is very complicated and affected by many variables. Cotton and blend fabrics are more than 40% of the present U.S. market; National Purchase Dairy (NPD) data indicates that cotton is greater than 50% of the fiber used in the U.S. in this market (871,600/1,513,500 480-lb bales). It has been shown that smolder ignition resistance of cellulosic fabrics can be adversely affected by open flame ignition resistance treatments. CPSC should be required to address the issue of the effect of open flame ignition resistance treatments on smolder ignition propensity of cellulosic upholstery fabrics in any flammability standard for furniture that CPSC shows is necessary.

There is question about the human and environmental toxicity of fire retardant treatments that would be anticipated to be used for upholstered furniture fabrics to meet the draft 2001 CPSC standard for flammability of upholstered furniture. To avoid another "Tris" situation that would put textile fabric manufactures at risk, CPSC should require verification of the safety of any fire retardant treatments used to meet any standard they show is necessary.

Any flammability standard that CPSC promulgates for upholstered furniture must address an unreasonable risk, be the least burdensome alternative, be economically and technologically feasible, address human, workplace and environmental risk, and be cost effective/beneficial.

#### More specifically.

#### 1. CPSC should recognize that fire retardant treatments for open flame resistance can adversely affect smoldering ignition propensity.

Once ignited, virtually all common textile fabrics will burn. Textile fabrics burn by two distinctly different processes. Since the fibers that make up the fabrics are composed of large, non-volatile polymers, flaming combustion (e.g., that caused by an open flame source, such as a match) requires that the polymer undergo decomposition to form the small, volatile organic compounds that constitute the fuel

for the flame. For many common polymers, this degradation is primarily pyrolytic with little or no thermo-oxidative character. Smoldering or glowing combustion (e.g., that caused by a cigarette) on the other hand involves direct oxidation of the polymer and/or chars and other non-volatile degradation products. Smoldering is also subject to acceleration by common alkali metal ions such as sodium, potassium or calcium (J. Krasney, Texile Chemist Colorist 24 (11) 12, 1992). These metal ions catalyze the oxidation reaction, producing more rapid heat release and promoting smoldering. Cotton in both the raw state and as dyed and finished fabric frequently contains metal ions in sufficient quantity to cause smoldering when exposed to a cigarette or similar ignition source. Laundering, or even water soaking, of cotton fabrics often reduces the metal ion content to such a level that the fabrics are not ignited by cigarettes. Conversely, soiling of cotton or rayon fabrics may cause a previously smolder-resistant material to become ignition-prone

Reports indicate that flammability of cellulosic fabrics is very complicated and that smolder ignition propensity of some cellulosic fabrics is affected by open flame ignition resistance treatments.

CPSC 2001 Briefing Package. Khanna (Cigarette - Open Flame Relationship. CPSC Memorandum to Dale Ray. Oct. 23, 2001; 2001 CPSC Briefing Package, p. 232) concludes from CPSC testing that the 2001 CPSC draft standard contains provisions to limit both flaming and smoldering combustion; that although the standard does not utilize a smoldering ignition source, the provisions account for smoldering combustion. This may be true for some upholstered furniture fabrics but their own testing indicates that "Cellulosic flame resistant treated upholstry fabrics may not always resist both small open flame and cigarette ignition." [L. Fansler, CPSC Technical Report: Summary of Flammability Tests Upholstered Furniture Project (1998-2000). Oct. 19, 2000; 2001 CPSC Briefing Package, p. 246]. In a CPSC test three FR backcoated fabrics ignited when exposed to a cigarette (G. Stafford and A. Bernatz. UFAC vs. CPSC Cigarette Tests of Upholstery Fabrics. CPSC Memorandum to Dale Ray. May 30, 2000; 2001 CPSC Briefing Package, pp.514-522). All the fabrics that ignited were cellulosic (cotton) fabrics. UK chair study: 21 chairs with complying FR-fabrics (14 predominately cellulosic; 7 thermoplastic) were tested using a mockup over non-FR-foam. Three of 14 cellulosic failed the cigarette ignition test. Additional fabrics: 40 fabrics (21 FR; 19 non-FR) were tested in the UFAC and CPSC mock-up test. 34 of 40 resisted cigarette ignition; 6 cotton fabrics, including 3 FR-backcoated fabrics ignited.

UFAC studies. Tests by UFAC have shown that cigarette ignition propensity of 100% cotton fabrics does not correlate with the weight of the fabric (J. Ziokowski and H. Talley. 1999. The Effects of FR Backcoatings on the Cigarette Ignition Propensity of 100% Cotton Fabrics. Paper presented at the AFMA Flammability Conf. Mar. 9, 1999). Also in studies with fabrics backcoated in the US and the UK to pass BS 5852 and the 1997 CPSC tests, most cotton fabrics that were UFAC Class I became Class II. [This is considered a failure of the test; UFAC Class II fabrics require an approved barrier between the fabric and conventional polyurethane foam in the horizontal seating surfaces; Class I fabrics can be used directly over conventional polyurethane foam.] The authors concluded that the fire performance of cellulosics is very complex and depends on many things, such as, method of yarn preparation (e.g., open-end vs. ring spun), yarn type, fabric construction, and dyeing and finishing methods. Whether the cigarette is on a horizontal surface (e.g., mattress test) or in the crevice/vertical surface (e.g., furniture test) can affect the results of smolder ignition tests. The aesthetic of the 100% cotton fabrics were also altered by the FR-backcoating.

Smolder Ignition Studies. Hirschler (M.M. Hirschler. Comparison of the Propensity of Cigarettes to Ignite Upholstered Furniture Fabrics. Fire and Materials 21 123-141, 1997) investigated the smoldering cigarette propensity of upholstery fabrics typically available in the consumer marketplace. Of the 500 fabrics tested, 145 fabrics were ignitable by cigarettes; all of them predominantly (or completely) cellulosic. Hirschler found a fabric density threshold (8-9 oz/yd²) above which the percentage of cellulosic fabrics that are ignitable and flame spread rate of fabrics in a flaming ignition test are all unaffected. Others have found that lighter weight fabrics (< 6-7 oz/yd²) are usually better (mostly Class I fabrics) than heavier weight cotton fabrics in the UFAC fabric classification (smolder) test.

The <u>CA BHF</u> in reports/publications by <u>Damant et al.</u> in the <u>1970's</u> (e.g., G.H. Damant and M.A. Young, Smoldering Characteristics of Fabrics Used as Upholstered Furniture Coverings, *J. Consumer Prod. Flamm.* 4, 60-113, 1977) found that:

"treatments to reduce flammability are usually ineffective as smolder inhibitors, and sometimes only compound and intensify smoldering problems"; cellulosic fabrics are the most hazardous and the hazard increases as the fabric weight increases; thermoplastic fabrics (of adequate weight) perform well in cigarette tests; cellulosic/thermoplastic blends >36% thermoplastic pass the smoldering combustion tests and as the % themoplastic approaches 35% the tendency to smoldering is greatly diminished.

The <u>USDA</u>, <u>ARS</u> studied smolder resistance extensively in the late 60's and the 70's and developed many treatments for cotton and cotton blend fabrics (e.g., D.J. Donaldson, et al. Smoldering Phenomenon Associated with Cotton, *Textile Res. J.* 53, 160-164, 1983 and D.D. Donaldson et al. Smoldering Characteristics of Cotton Upholstery Fabrics, *Textile Res. J.* 51, 196-202, 1981). They found that cellulosic fabrics are very variable and metal salts increased the smoldering of cotton fabrics.

ATMI/AFMA Study. In 1998, 31 upholstery fabrics, selected to represent the variety of fiber types, fiber blends, weights, and constructions typical in the marketplace, were sent to a commercial backcoating operation in the United Kingdom. Each fabric was treated with a FR latex backcoating (decabrom and Sb<sub>2</sub>O<sub>3</sub> and acrylic latex) in the U.K. to comply with the British Furniture and Furnishings Regulation (BS 5852). Two of the 31 ATMI/AFMA fabrics could not be treated to meet the British test criteria. The other 29 fabrics were found to meet the requirements of the British regulation by a NAMAS<sup>1</sup> certified laboratory and were returned to the U.S. for further testing.

Reimann (K.A. Reimann. Evaluation of CPSC Upholstered Furniture Flammability Test. *Proc.* 2000 Beltwide Cotton Conferences. National Cotton Council, Memphis, TN 2000. pp.827-837) tested the 31 fabrics for open flame ignition using the 1997 CPSC draft standard. [CPSC 1997 test and BS 5852 are similar. Some of the differences are: the butane gas delivery system for the CPSC test is more complex; the BS 5852 test is over CMHR foam and the CPSC test is over non-FR foam; the fabric soaking procedure (BS 5852 30 min. in specified hardness water; CPSC 24h soak in tap water); and the pass/fail criteria (BS 5852: smoldering is allowed if it extinguishes in < 15 min., flaming can not extend to the sample sides or seat front although a flame can extend up past the top of the seat back if it recedes and self extinguishes in < 120 sec.; CPSC test failure

<sup>&</sup>lt;sup>1</sup> National Accreditation of Measurement and Sampling, a service of the United Kingdom Accreditation Service (UKAS). UKAS specifies criteria that laboratories must meet. Only a laboratory that has been accredited by UKAS can issue of NAMAS report or certificate.

when any smoldering occurs > 120 sec. or when the sample burns or smolders to any edge, top, sides or seat front). The CPSC 2001 test differs from the CPSC 1997 test. The main differences are that the pass/fail criteria post-ignition smoldering/glowing combustion time is extended from 120 sec. to 15 min. and a seating barrier test is added as an alternative to the seating area test. BS 5852 now has a 15 sec. ignition time and the EU is considering adopting the current BS 5852 as a CEN standard. Also, there is movement in the U.K. to change the British FFR to 15 sec. Thus all of the European standards would be different from the 2001 CPSC test.] Fourteen of the fabrics failed the CPSC 1997 test. Five of the seven 100% cotton fabrics and four of the ten cotton blend fabrics failed the test (see Reimann, Table F). Some of the fabrics that failed the 1997 CPSC test might pass the 2001 CPSC test because of the change in pass/fail criteria for smoldering (120 sec. to 15 min.).

In 1999, 30 of the 31 fabrics were tested at the Grundy Textile Evaluation Laboratory, Philadelphia University for UFAC fabric classification before the FR-backcoating was applied and again after FR-backcoating (Philadelphia University. A Study of the Effects of FR Backcoating on Selected Upholstery Fabrics, The Grundy Textile Product Evaluation Laboratory of Philadelphia University, June 16, 1999). The results were as follows:

- 1 fabric improved in cigarette ignition resistance (UFAC Class II became UFAC Class I)
- 5 fabrics became <u>less resistant</u> to cigarette ignition (UFAC Class I became UFAC Class II)
- 24 fabrics did not change their UFAC Classification (all remained UFAC Class I).

A Class II fabric is considered a failure in the UFAC fabric classification test.

Further analysis of the test data shows that of the 12 fabrics in the study which are predominately cellulosic (≥ 70% cotton, rayon, or linen) (see the Table below)

- For 1 fabric, resistance to cigarette ignition improved. (8%).
- For 5 fabrics, resistance to cigarette ignition got worse (failed the UFAC test). (42%)
- For 6 fabrics, resistance to cigarette ignition was unchanged. (50%)
- Whether a cellulosic fabric changed from Class I to Class II or remained Class I was not correlated with fabric weight or percentage add-on of the backcoating

#### Summary of UFAC Fabric Classification (Smolder) Test results for FR-treated Fabrics

Gintle (c	filles = Congrad	W: (6.2. <b>6</b> 3)	等 14.7% A.C. 在达得一点,"你一点,""" "这个,这个"这个"(2.15) "	ins. (Classification Test resource in the reso
I	92% cotton, 8% rayon	20.2	11 2.24 64	Class II to Class I (passed BS 5852; passed CPSC 1997)
T	100% cotton	7.5	21 1.58 45	Class I to Class II (passed BS 5852; failed CPSC 1997)
Z	59% linen, 41% cotton	7.6	10 0.74 21	Class I to Class II (passed BS 5852; failed CPSC 1997)
Y	100% cotton	10.7	16 1.72 49	Class I to Class II (passed BS 5852; failed CPSC 1997)
BB	100% cotton	6.9	25 1.75 50	Class I to Class II (passed BS 5852; failed CPSC 1997)

CC	100% cotton	6.6	17 32	1.12	Class I to Class II (passed BS 5852; failed CPSC 1997)
A	60% cotton, 12% rayon, 28% nylon	22.7	9 61	2.14	Stayed Class I (passed BS 5852; failed CPSC 1997)
C	96% rayon, 4% PET	18.7	5 26	0.91	Stayed Class I (passed BS 5852; passed CPSC 1997)
E	100% cotton	6.7	15 28	0.98	Stayed Class I (passed BS 5852; passed CPSC 1997)
F	62% rayon, 38% cotton	13.9	7 27	0.95	Stayed Class I (passed BS 5852; passed CPSC 1997)
G	100% cotton	12.8	22 79	2.77	Stayed Class I (passed BS 5852; failed CPSC 1997)
Н	100% cotton	10	17 48	1.68	Stayed Class I (passed BS 5852; passed CPSC 1997)

Summary: Inhibition of smoldering combustion and flamming combustion require very different types of chemical retardant action. The behavior in flammability tests of cellulosic fabrics, which are more than 40% of the present U.S. upholstered furniture market presently, is very complicated. Flammability of cellulosic fabrics is affected by fabric weight, yarn construction (e.g., open-end vs. ring spun), fabric construction, alkali metal content (J. Krasney. A Simple Method for Reducing Cigarette Fires. Text Chemist Colorist 24(11), 12, 1992), and dyeing and finishing methods as well as other variables. CPSC should fully consider the effect of open flame ignition resistance treatments for cellulosic fabrics on smolder ignition resistance of these type fabrics in any open flame ignition standard shown to be necessary.

#### 2. To avoid another "Tris" situation for textile manufacturers, fire retardants that are used to meet a CPSC open flame standard should meet the toxicity requirements for fire retardants in the revised EU eco-label for textiles.

The 2001 CPSC test, although a performance standard, anticipates the use of fire retardant treatments to meet the open flame resistance requirements. In Europe there is great concern about the human and environmental toxicity of brominated and other fire retardants, because they can be persistent, bioaccumulative, and toxic. Some of these concern are discussed in "Bominated Flame Retardants and the Environment", a special issue of *Chemoshere* 46 Feb. 2002, edited by M. Alaee and R. Wenning (http://www.elsevier.nl/locate/jnlnr/00362). Several of the major producers of brominated fire retardants have indicated that they expect these chemicals to be banned in Europe soon.

At a minimum any fire retardants used to meet any CPSC open flame standard for upholstered furniture should comply with requirements of the EU Eco-label for textiles and the SIDS (Standard Information Data Set) test requirement as well as the requirements of EPA TSCA and the CPSC administered FHSA to assure that a situation like what occur in 1977-78 with "Tris" and children's sleepwear does not occur and put manufacturers of upholstered furniture fabrics at risk.

The revised *The European ecological label for textile products* was approved on 20 Feb. 2002 (<a href="http://europa.eu.int/comm/environment/ecolabel/pdf/textiles/drafteriteriafinal\_190202.pdf">http://europa.eu.int/comm/environment/ecolabel/pdf/textiles/drafteriteriafinal\_190202.pdf</a>). This revises the eco-label for textiles that was issued in 1998. "No use is allowed of flame retardant substances or of flame retardant preparations containing more than 0.1% by weight of substances that are assigned or may be assigned at the time of application any of the following risk phases (or combinations thereof):

R40 (limited evidence of a carcinogenic effect),

R45 (may cause cancer),

R46 (may cause heritable genetic damage),

R49 (may cause cancer by inhalation),

R50 (very toxic to aquatic organisms),

R51 (toxic to aquatic organisms),

R52 (harmful to aquatic organisms),

R53 (may cause long-term adverse effects in the aquatic environment),

R60 (may impair fertility),

R61 (may cause harm to the unborn child),

R62 (possible risk of impaired fertility),

R63 (possible risk of harm to the unborn child),

R68 (possible risk of irreversible effects)

As laid down in Directive 67/548/EEC and its subsequent amendments."

Assessment and verification: "... indicate which flame retardants have been used and provide documentation (such as safety data sheets) and/or declarations indicating that those flame retardants comply with this criterion."

#### 3. Summary

It is well understood that inhibition of smoldering combustion and flaming combustion require very different types of chemical retardant action. Smolder retardants can be either physical barriers or oxidation inhibitors. Flaming combustion retardants cause inhibition by alteration of either the decomposition or oxidation reactions. Backcoatings utilize gas-phase-active retardants, which act as flame poisons to prevent flaming combustion and can be effective on virtually all fiber types. However, backcoatings need to be considered as systems, not individual compounds, since the halogenated compounds are not effective unless they are combined with antimony oxide to make them an effective flame poison and an acrylic resin to make them semi- to fully durable.

It has been shown that some backcoating and fabric treatments, which most likely would be used to prevent open flame ignition of upholstered fabrics, can negatively affect smolder resistance of cellulosic fabrics. Published literature indicates the behavior of 100% cellulosic and cellulosic blend upholstery fabrics (more than 40% of the present U.S. market) in flammability tests is complicated and dependant on many factors, such as. fabric weight, fabric construction, yarn preparation (open-end vs. ring spun), alkali metal content, and dyeing and finishing methods as well as possibly other variables.

Effective mandatory or voluntary standards for open flame ignition of upholstered furniture or mattress/bedding need to consider the effect of open flame ignition resistance treatments on smolder ignition resistance. Any fire retardant chemicals used to meet any CPSC flammability standard for upholstered furniture should meet strict toxicity requirements to avoid another "Tris" situations for textile manufacturers.

Any mandatory open flame standard for upholstered furniture that CPSC promulgates should be reasonable and appropriate, technologically feasible, and cost beneficial. NCC appreciates the opportunity to provide this testimony to CPSC for this rulemaking to address open flame ignition of upholstered furniture. Please contact me if there are any questions (202-745-7805; <a href="mailto:pwakelyn@cotton.org">pwakelyn@cotton.org</a>).

# CPSC Upholstered Furniture Public Meeting June 18-19, 2002

P.J. Wakelyn, NCC

## INTRODUCTION

- Smolder and Open Flame combustion differ
- complicated & affected by many variables Behavior of cellulosic fabrics very
- Cellulosic fabrics >40%; 871,600/1,513,500 (480 lb bales)
- Affect of open flame resistance treatments on smolder ignition propensity?
- Fire retardants for open flame standard for furniture should meet toxicity requirements

## treatments affect smolder ignition CPSC Should recognize that open flame ignition resistance

- Open-flame vs Smolder
- U.S. CPSC 2001 Briefing Package (21 UK chairs; 40 fabrics)
- **UFAC Studies**
- Smolder Ignition Studies
- Hirschler (145/500 failed)
- CA / Damant
- USDA

## ATMI/AFMA Study

- 31 fabrics backcoated to meet BS 5852
- Treatment: Decabrom, Sb<sub>2</sub>O<sub>3</sub>, Acrylic latex
- BS 5852 vs. CPSC 1997 vs. CPSC 2001

# Results of Open Flame Test (BS 5852)

2 of 31 fabrics did not pass BS 5852

## Results of Open Flame Test (CPSC 1997)

- 14 failed CPSC 1997
- 5 or 7 100% cotton failed
- 4 of 10 cotton blend fabric failed

## Results of Smolder Test (cigarette) (UFAC fabric classification)

- 1 fabric (cellulosic) improved (Class II to Class I)
- 5 fabrics (cellulosic) less resistant (Class I to Class II)
- 24 fabrics no change (including 6 cellulosic fabrics)
- Change in smolder resistance not correlated w/ fabric weight and % add-on

# Summary of Results for 12 Cellulosic Fabrics

									Γ									
UFAC Fabric Classification Test results before and after FR-backcoating (open flame test results)	Class II to Class I (passed BS 5852; passed CPSC 1997)	TOOL DOUD L F. J. CJOJ DU F / II	Class I to Class II (passed BS 5852; failed CFSC 1991)	ii (passea <b>D</b> 2 5052, ialiea (1 50 1771)	Class I to Class II (passed BS 5852; failed CPSC 1997)	Class I to Class II (passed BS 5852; failed CPSC 1997)	Class I to Class II (passed BS 5852; failed CPSC 1997)	-	(passed BS 5852; failed CPSC 1997)			(passed BS 5852; passed CPSC 1997)		(passed BS 5852; passed CPSC 1997)	(passed BS 5852; passed CPSC 1997)	•	(passed BS 5852; failed CPSC 1997)	(passed BS 5852; passed CPSC 1997)
UFACEabric results before test results)	Class II to Clas	10 11 11	Class I to Class	CCBI O I CCBI O	Class I to Class	Class I to Class	Class I to Class		Stayed Class I			Stayed Class I		Stayed Class I	Stayed Class I		Stayed Class I	Stayed Class I
Bei	64	16	21	1	49	50	32		61			26		28	27		79	48
Add-on % 07	2.24	1 60	0.74		1.72	1.75	1.12		2.14			0.91		0.98	0.95		2.77	1.68
<b>Ad</b> c	11	5	101	?	16	25	17		6		,	\$		51	2		22	17
7 (1) 20 96 (20) 0 (20)	20.2	3.0	7.6	?	10.7	6.9	9.9		22.7			18.7		6.7	13.9	į	12.8	10
Code Ribert & Content	92% cotton, 8% rayon	1000/ 00440=	59% linen	41% cotton	100% cotton	100% cotton	100% cotton		60% cotton,	12% rayon,	28% nylon	96% rayon,	4% PET	100% cotton	62% rayon,	38% cotton	100% cotton	100% cotton
Code	ı	ŀ	7	1	Y	BB	သ		А			ပ		E	ഥ		Ŋ	Н

## furniture fabrics should meet toxicity Fire retardants used on upholstered requirements

- Sb203
- EU eco-label for textiles
- SIDS / HPV / TCSA / FHSA

## Summary

- Inhibition of smolder combustion and flaming combustion different
- Backcoating and fabric treatments can affect smolder resistance adversely
- Behavior of cellulosic fabrics in flammability tests complicated; dependant on many factors
- Standards for open flame ignition resistance need to consider effect on smolder ignition propensity
- Br compound not affective without Sb2O3 + acrylic resin for durablity
- FR chenicals should meet toxicity requirements



#### Fire Retardant Chemicals Association

1681 CROWN AVENUE • SUITE 202 • LANCASTER, PA 17601 PHONE: (717)291-5616 • FAX: (717)295-8455

May 17, 2002

Mr. Dale Ray Project Manager Directorate of Economic Analysis U.S. Consumer Product Safety Commission Washington, D.C. 20207

Dear Mr. Ray:

Thank you for the opportunity to comment on the draft upholstered furniture flammability standard contained in the October 30, 2001 briefing materials labeled *Upholstered Furniture Flammability: Regulatory Options.* Please consider this our request to testify at the June 18-19 hearings on this subject.

From the outset, the Consumer Product Safety Commission ("CPSC") has focused on preventing the ignition of fabrics by small open flame, and in effect, ignored the possibility of fire spread in the event of fabric failure. The biggest potential fuel source in upholstered furniture is the fill, and yet the CPSC's draft standard fails to properly address this. In fact, CPSC research claims to show that polyurethane foam, the most popular cushioning material, has little impact on the slowdown of fires; therefore, there is no need to treat it. In short, the proposed standard encourages the use of more flammable filling materials.

As originally proposed, the standard addressed the issue of flame propagation by making one of the criteria for test failure the spread of flame beyond the furniture's edge. The concern was the possibility of secondary ignition of such items as draperies and carpets, which could greatly increase the severity of a fire. Fabric on upholstered furniture that can withstand small open flame Ignition could very well burn through to the highly flammable fill when confronted with a large flame.

More recently, the CPSC amended its draft standard to allow for the use of a barrier layer as an alternative to flame-retarded cover fabrics. The use of a barrier layer, a fire-resistant material sandwiched between the upholstery fabric and the fill, would prevent the ignition of the cushioning material. However, if a barrier layer is used, limited flame spread is no longer a test criterion; flame propagation is a non-issue. The cover fabric could burn away completely, and a passing rating would still be achieved as long as the barrier remained intact. In short, this option encourages the use of highly flammable fabrics.

With this draft standard, the two testing options are completely at odds with each other. If upholstery fabrics are to be treated to avoid ignition and prevent the ignition of secondary fuel sources, the fabric should not be allowed to burn in its entirety simply because a barrier layer is used. If the intent of a barrier layer is to prevent the burning of the fill, then filling materials should be flame resistant in furniture constructions where barrier layers are not utilized. This should not be an either/or testing procedure. The protection of the fill, whether by barrier layer or chemical treatment, should be a back-up safety measure in case of performance failure by ignition resistant upholstery fabrics.

Imagine, if you will, a living room or den in which a couch is flanked by two upholstered chairs. Assume all pieces pass the proposed CPSC standard, but the couch is made up of flame-retarded fabric over untreated foam whereas the chairs are constructed of untreated fabric over barrier layers. Suppose a small child playing with a lighter ignites one of the chairs. The fabric begins to burn and soon the spread of unchecked flame ignites the adjacent sofa. These flames, being of much greater size than the small open flame of the CPSC test method, burn through the treated fabric of the couch and quickly ignite the highly flammable polyurethane foam. The fire now spreads to the remaining chair, the draperies and other items within the room and progresses to the flashover stage. Had the chairs been upholstered in fabric treated to limit flame propagation, the couch would not have caught fire. Had the foam interior of the sofa been flame-retarded, the fire would have been checked and flashover would not have occurred. At the very least, furniture constructed with flame-retarded fabrics over treated or protected fill would extend the escape time of the child or other persons within the home.

It is our belief that any standard that does not call for all furniture components to be flame resistant is flawed and must be reconsidered. The California Bureau of Home Furnishings and Thermal Insulation is of the same opinion. This organization has chosen to modify its upholstered furniture standard of twenty years, California Technical Bulletin 117, to address the limitations of the fabric portion of its current test method and to make more stringent the test for cushioning materials. The new standard will even incorporate a composite test to address the issue of possible negative synergies between furniture components.

The CPSC standard should mimic that of the CAL 117 test or that of British Standard 5852. This latter test has been in existence in the United Kingdom for more than ten years and, like CAL 117, has a great deal of historical data to prove its effectiveness and relative ease of use.

The efforts of the CPSC are commendable, and it is obvious a great deal of time and effort has been expended to develop a standard for the resistance of upholstered furniture to small open flame. Although the CPSC is on the right track, this draft standard should be rethought and rewritten to emphasize both the prevention of ignition and the limitation of flame spread.

Thank you for your interest in this important matter.

Sincerely,

William E. Horn, Jr. Executive Vice President

## CONSUMER PRODUCTS SAFETY COMMISSION

Upholstered Furniture Flammability: Regulatory Option

June 18/19, 2002

Akzo Nobel Functional Chemicals LLC
Phosphorus Chemicals
5 Livingstone Avenue
Dobbs Ferry, New York 10522
914-674-5394

# [Tris-(1,3-dichloro-2-propyl) Phosphate] "TDCPP"

- Flammable Fabrics Act of 1953 Established need for flameproof fabrics
- "TDCPP" used to meet MVSS 302
- "TRIS" (tris[2,3-dibromopropyl] phosphate) was widely used to confer tlame retardancy to fabrics
- 1975 "TRIS" shown to be mutagenic
- 1978 "TRIS" shown to be carcinogenic
- To maintain flammability standards substitutes sought

#### **Acute Toxicity**

Acute Oral LD50

Rat:

Mouse: Rabbit:

2830 mg/kg 7500 mg/kg 6800 mg/kg

Acute Dermal LD50

Rabbit: >23,900 mg/kg

Acute Inhalation LC50

Rat:

>9.8 mg/1

Primary Eye Irritation:

Non-irritant

Primary Skin Irritation:

Mild irritant

## LOW ACUTE TOXICITY

AKZO NOBEL

## Subchronic Toxicity

- 90-Day Oral Toxicity Study Conducted by CPSC
- 90-Day Dermal Toxicity Study Conducted by CPSC

No significant target organ toxicity

#### Neurotoxicity

- Acute Neurotoxicity Study in Hens
- Subchronic (90-Day) Neurotoxicity

## NO NEUROTOXICITY



# Developmental Toxicity (Teratogenicity)

- Teratology study conducted in pregnant rats
- Maternal toxicity observed when maximum tolerated dose ("MTD") administered
- No developmental anomalies in the offspring

## NO TERATOGENIC ACTIVITY

## Reproductive Toxicity

- Reproductive toxicity study by CPSC in rabbits
- Reproductive toxicity study by Stauffer in rats



#### Mutagenicity

Six Ames Tests

Negative

One Ames Test

Weak Positive

Chinese Hamster Lung V79 Test

Negative

Mouse Lymphoma Point Mutation

Negative

Mouse Lymphoma Chromosomal

Positive

Two Unscheduled DNA Repair Assays Negative

Drosophila melanogaster

Negative

Mouse Bone Marrow Cytogenetics

Negative

WEIGHT OF EVIDENCE: NOT MUTAGENIC

AKZO NOBEL

#### Carcinogenicity

- Two year cancer bioassay conducted in rats
- Fyrol FR-2 administered daily in the diet
- Microscopic examination of all tissues
- Increased incidence of benign tumors
- No significant increase in malignant tumors
- Tumors observed commonly occur in aging rats
- An NOEL clearly established
- Mechanism for increased benign tumors not known
- Epigenetic mechanism based on lack of genotoxicity

AKZO NOBEL

NOT CARCINOGENIC (DID NOT INDUCE MALIGNANT TUMORS) 7

- 1981 Very Conservative One-Hit Model
- o Migration from polyurethane foam
- o Estimated human exposure from diffusion rates
- o Used tumor incidence from chronic study
- o Maximum exposures considered "virtually safe"
- 1983 One-Hit, Linear Multistage, and Probit Models
- o Independent assessment using three models
- o Assumptions used in models: exposure 8 hrs/day, 70 yrs, with 14% absorption
- o No increased cancer risk

NO ADVERSE HUMAN HEALTH RISKS FROM FOAM USE

- In commerce 30+ years
- Reduces ignition of plastic materials
- Must be used responsibly
- Different than "TRIS" and other FR substances
- Risk analysis models must be relevant

# NEW CHEMICAL PRODUCTS